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19-2981; Rev 0; 9/03

MAX1909 Evaluation Kit

Evaluates: MAX1909

General Description

The MAX1909 evaluation kit (EV kit) is an accurate and efficient multichemistry battery charger. The EV kit can charge three or four series Li+ cells with a current up to 3A. Charge current and input-source current are adjustable using on-board potentiometers. The output voltage is set to 4.2V × the number of series cells in the battery pack. The number of series cells is jumper-selectable. The output voltage is adjustable between 4V to 4.4V (× number of series cells) by installing two resistors. The EV kit provides outputs to monitor the AC adapter current and the presence of an AC adapter.

The MAX1909 automatically selects the power path for supplying power to the system by controlling two external P-channel MOSFETs. This decision is made based on the presence of an AC adapter.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	10µF ±20%, 25V X5R ceramic capacitors (1812) Taiyo Yuden TMK432BJ106KM TDK C4532X5R1E106M
C3	0	Not installed (2220)
C4	1	22µF ±20%, 25V ceramic capacitor (2220) TDK C5750X5R1E226M
C5, C6	0	Not installed, E-size capacitors
C7, C9, C12, C17, C18	5	0.1µF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E104K TDK C1608X7R1E104K
C8, C13, C14, C15	0	Not installed, capacitors (0603)
C10, C11, C21	3	1µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J105K Taiyo Yuden JMK107BJ105KA TDK C1608X5R1A105K
C16	1	1µF ±10%, 25V X7R ceramic capacitor (1206) Murata GRM31MR71E105K Taiyo Yuden TMK316BJ105KL TDK C3216X7R1E105K
C19, C20	2	0.01µF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H103K Taiyo Yuden UMK107B103KZ TDK C1608X7R1H103K

Features

- **Input Current Limiting**
- **±0.5% Output Voltage Accuracy Using Internal Reference**
- **Automatic Selection of System Power Source**
- **Analog Inputs Control Charge Current and Charge Voltage**
- **Monitor Outputs for**
  AC Adapter Current
  AC Adapter Presence
- **Up to 17.6V Battery Voltage**
- **+8V to +25V Input Voltage**
- **Up to 3A Battery Charge Current**
- **Charges Li+, NiCd, and NiMH Battery Chemistries**
- **Surface-Mount Construction**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX1909EVKIT	0°C to +70°C	28 Thin QFN

Quick Start

Required Equipment

Before beginning, the following equipment is required:

- DC source to supply the input current to the charger. This source must be capable of supplying a voltage greater than the battery-voltage set point and have sufficient current rating.
- Voltmeter
- Battery pack or load

Procedure

The MAX1909 EV kit is a fully assembled and tested surface-mount board. Follow the steps below to verify board operation. **Do not turn on the power supply until all connections are completed. Observe all precautions on the battery manufacturer's data sheet:**

1) Set jumper JU1 to indicate the number of cells in the battery pack (Table 1).
2) Remove the shunt on JU2 to disable the MAX1909.
3) The battery regulation voltage is set to 4.2V per cell. If a different voltage is required, see the *Battery Regulation Voltage* section.
4) The charge current is set to 3A. If a different current is required, see the *Charging Current Limit* section.

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C22	1	2.2µF ±20%, 35V tantalum capacitor (B-size) AVX TAJB225M035 Kemet T491B225M035AS
D1	1	Schottky diode, 0.5A, 30V SOD-123 Diodes Inc. B0530W General Semiconductor MBR0530 ON Semiconductor MBR0530
D2	0	Not installed
J1	1	Smart-battery header assembly, right angle, keyless, five position Tyco Electronics (AMP) 787441-1
JU1, JU2	2	2-pin headers
JU3	0	Not installed
L1	1	10µH, 4.4A inductor Sumida CDRH104R-100NC TOKO 919AS-100M
N1	1	Single, N-channel, 8.4A, 30V, 8-pin SO MOSFET Fairchild FDS6612A
P1	1	Single, P-channel, -5.3A, -30V, 8-pin SO MOSFET Fairchild FDS9435A
P2, P3, P4	3	Single, P-channel, -11A, -30V, 8-pin SO MOSFETs Fairchild FDS6675
R1	1	0.01Ω ±1%, 0.5W sense resistor (2010) Vishay Dale WSL2010 0.010 1.0% IRC LRC-LR2010-01-R010-F
R2	1	0.015Ω ±1%, 0.5W sense resistor (2010) Vishay Dale WSL2010 0.015 1.0% IRC LRC-LR2010-01-R015-F
R3, R4, R8, R13, R14, R15, R17–R23	0	Not installed, resistors (0603)
R5	1	590kΩ ±1% resistor (0603)
R6	1	196kΩ ±1% resistor (0603)
R7, R12	2	50kΩ potentiometers (multiturn)
R9, R10, R11	3	10kΩ ±5% resistors (0603)
R16	1	33Ω ±5% resistor (0603)
R24	1	10Ω ±5% resistor (0603)
U1	1	MAX1909ETI (28-pin thin QFN-EP)

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
AVX	843-946-0238	843-626-3123	www.avxcorp.com
Diodes Inc.	805-446-4800	805-381-3899	www.diodes.com
Fairchild Semiconductor	888-522-5372	—	www.fairchildsemi.com
General Semiconductor	760-804-9258	760-804-9259	www.gensemi.com
International Resistive Co.	361-992-7900	361-992-3377	www.irctt.com
Kemet	864-963-6300	864-963-6322	www.kemet.com
Murata	770-436-1300	770-436-3030	www.murata.com
ON Semiconductor	602-244-6600	602-244-4545	www.onsemi.com
Sumida	847-545-6700	847-545-6720	www.sumida.com
Taiyo Yuden	800-348-2496	847-925-0899	www.t-yuden.com
TDK	847-803-6100	847-390-4405	www.component.tdk.com
TOKO	847-297-0070	847-699-1194	www.tokoam.com
Vishay Dale	402-564-3131	402-563-6296	www.vishay.com

Note: *Please indicate you are using the MAX1909 when contacting these manufacturers.*

5) The source current is set to 5A. If a different current is required, see the *Source Current Limit* section.
6) Connect the input current supply across the ADAPTER_IN and PGND pads.
7) Connect a battery pack or load between the BATT+ and BATT- pads.
8) Turn on the power supply.
9) Enable the MAX1909 by installing the shunt on JU2.
10) Verify current is being delivered to the battery.

Detailed Description

The MAX1909 includes all the functions necessary to charge Li+ batteries. The EV kit is shipped with a charge current of 3A and a battery regulation voltage of 4.2V x the number of cells in the battery pack.

The MAX1909 includes a battery-conditioning feature, which allows for the relearning of the battery pack capacity. For more information on the operation of the MAX1909, refer to the *Detailed Description* section of the MAX1909 data sheet.

Jumper JU1

Jumper JU1 selects the number of series cells to be charged. See Table 1 for jumper settings.

Table 1. Jumper Selection

JUMPER	JUMPER POSITION	FUNCTION
JU1	Closed*	MODE = LDO. Cell count = 4.
	Open	MODE = float. Cell count = 3.
JU2	Closed*	$\overline{PKPRES}$ = GND. MAX1909 enabled.
	Open	$\overline{PKPRES}$ connected to LDO through 10kΩ pullup resistor. The MAX1909 is disabled unless the battery thermistor is connected to THRM.
JU3	Closed* (shorted by PC trace)	VCTL = LDO. Battery regulation voltage set to 4.2V x the number of cells.
	Open	Battery regulation voltage can be set between 4V and 4.4V x the number of cells. Resistors R3 and R4 must be installed.

**Default position.*

Jumper JU2

Jumper JU2 controls the pack-presence $\overline{PKPRES}$ pin. A shunt on JU2 enables the MAX1909. Removing the shunt places the MAX1909 in shutdown mode.

If the battery pack used with the MAX1909 EV kit has a thermistor, remove the shunt on JU2 and connect the thermistor to the THRM pad.

Jumper JU3

Jumper JU3 connects VCTL to LDO. This sets the battery regulation voltage to 4.2V x the number of cells.

The battery regulation voltage can be set between 4.0V and 4.4V (x the number of cells) by cutting the short across JU3 and installing resistors at R3 and R4. See the *Battery Regulation Voltage* section for more information.

Battery Regulation Voltage

The default battery regulation voltage on the MAX1909 EV kit is 4.2V x the number of cells. To set it to a value between 4.0V and 4.4V (x the number of cells), remove the shunt on JU1 and install resistors at R3 and R4. Use the following equation to calculate the resistor values:

$$R3 = R4 \left[\frac{5.4}{9.523\left(\frac{V_{BATT}}{CELLS} - 4.223 \right) + 1.8} - 1 \right]$$

V_{BATT} is the desired battery regulation voltage and CELLS is the number of cells selected by jumper JU1.

Choose 1% resistors with a total resistance less than 250kΩ to minimize error caused by bias current.

For V_{BATT} / CELLS = 4, use 100kΩ for R4 and leave R3 uninstalled.

For V_{BATT} / CELLS = 4.4, use 100kΩ for R4 and 49.9kΩ for R3.

Charging Current Limit (Potentiometer R7)

The default charging current limit on the MAX1909 EV kit is 3A. To set it to a value between 0.156A and 5A, adjust potentiometer R7. Refer to the *Setting the Charging Current Limit* section of the MAX1909 data sheet for more information. **Note:** 5A charging current requires a different inductor.

Source Current Limit (Potentiometer R12)

Potentiometer R12 is connected to CLS, the source current-limit input. Adjusting R12 allows the input current limit to be set between 3.75A and 7.5A. Refer to the *Setting the Input Current Limit* section of the MAX1909 data sheet for more information.

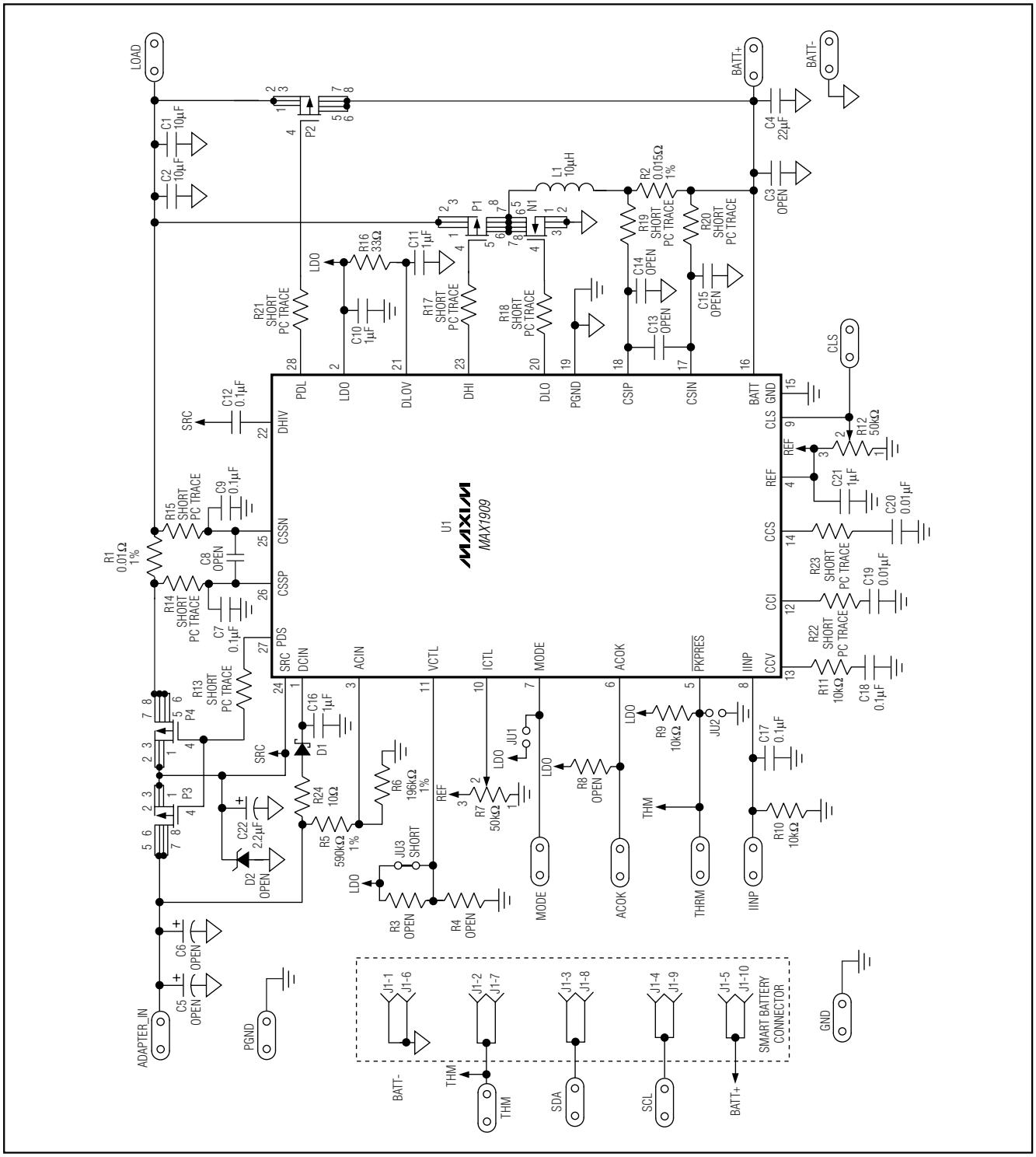

Figure 1. MAX1909 EV Kit Schematic

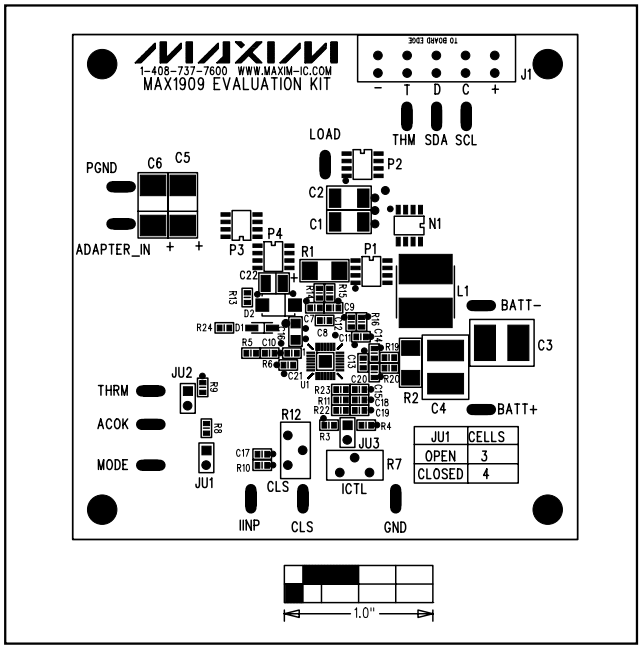

Figure 2. MAX1909 EV Kit Component Placement Guide—Component Side

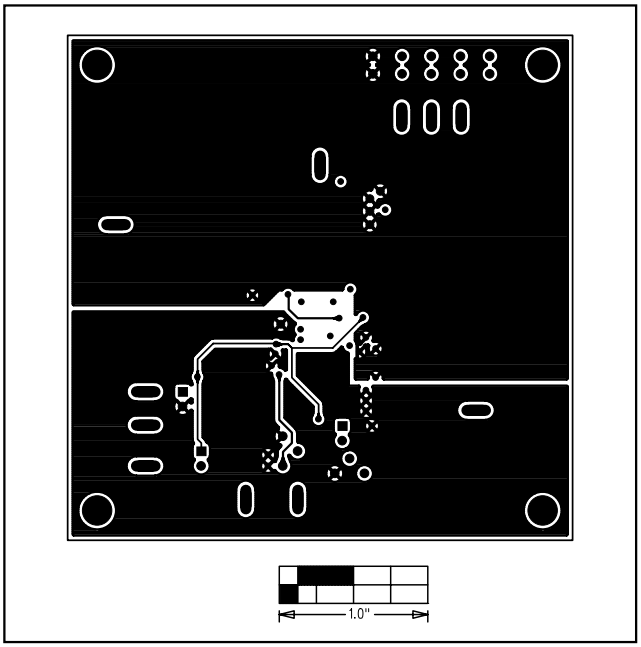

Figure 4. MAX1909 EV Kit PC Board Layout—Signal and Ground Layer

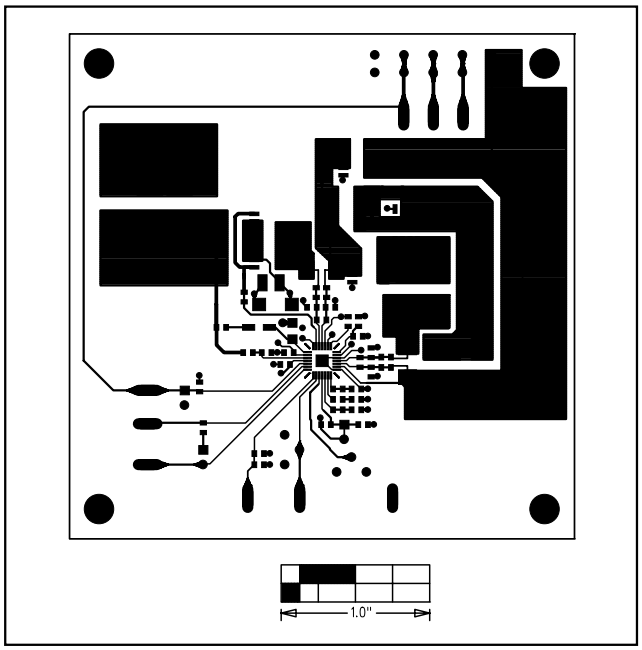

Figure 3. MAX1909 EV Kit PC Board Layout—Component Side

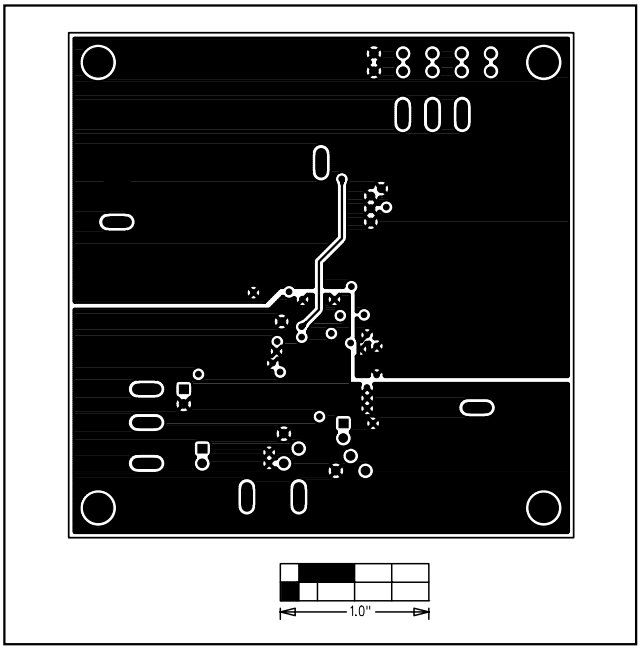

Figure 5. MAX1909 EV Kit PC Board Layout—Ground Layer

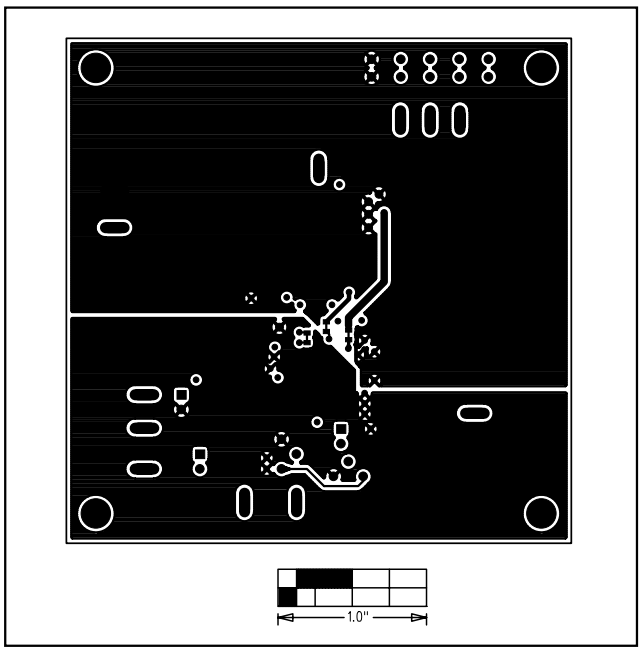

Figure 6. MAX1909 EV Kit PC Board Layout—Solder Side

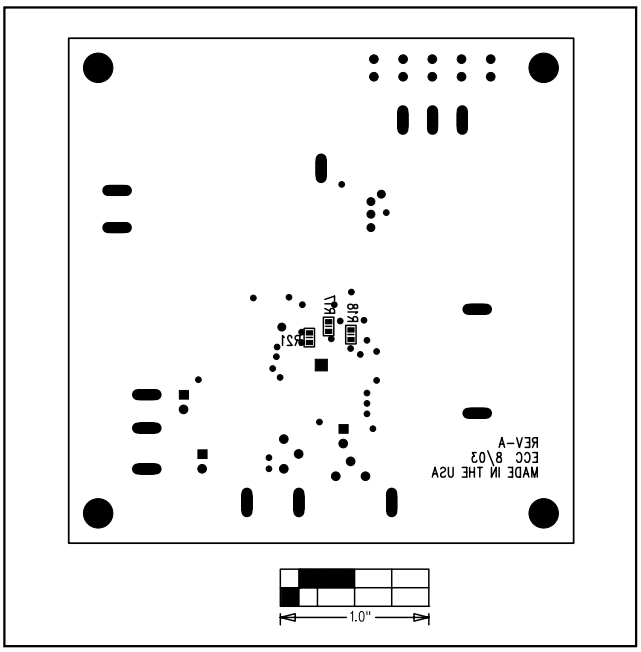

Figure 7. MAX1909 EV Kit Component Placement Guide—Solder Side

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